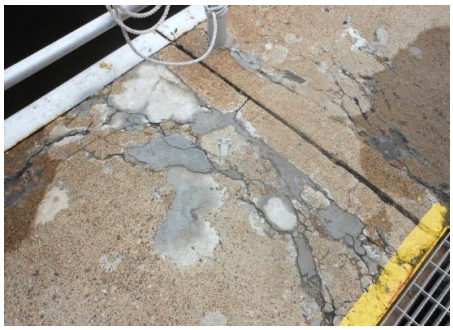
Horizontal Concrete Repair Materials for Inland Navigation Structures

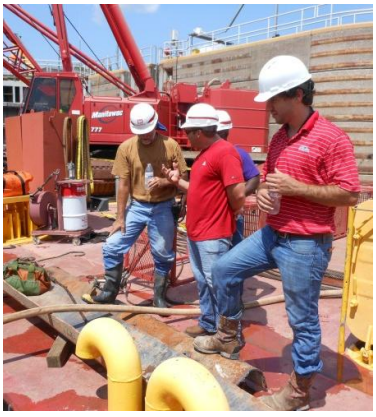
Problem



Deterioration of horizontal concrete surfaces (e.g., lockwall surfaces, parking areas, spillways, sidewalks, etc.) is a common problem across USACE, particularly in aging structures with inadequate resistance to cyclic freezing and thawing. Exposure to deicing salts and physical forms of abrasion can also lead to additional concrete deterioration. Other forms of deterioration include erosion, scour, and cavitation in underwater locations such as stilling basins. Deterioration of this type can reduce occupant safety, effect mechanical systems, and possibly alter operations. However, due to their low criticality when compared with catastrophic modes of failure (e.g., damage to a miter gate), this type of concrete deterioration often goes unrepaired, leading to subsequent deterioration of the underlying concrete or other structural components. New material technologies can improve the performance of these systems and the ease of repair. Along with these new materials, robust testing protocols and guidance must be developed to evaluate material properties to ensure they conform to desired mechanical properties (e.g., strength, bond, shrinkage), durability (e.g., thermal cycling, freeze/thaw, salt scaling), and serviceability (e.g., skid resistance) requirements.

Approach

The objective of this research is to investigate materials and methods to cost effectively repair deteriorated horizontal concrete surfaces in inland navigation structures in both in-the-dry and in-the-wet conditions. New materials under investigation for this application include rapid repair materials, shrinkage reducing admixtures, fiber reinforcement, polymer modified repair materials, and other technologies. In In-the-dry repairs are being investigated using typical repair techniques consisting of removal of unsound concrete. In-the-wet repair will focus on rapid methods to perform repairs underwater and will evaluate their long-term perform when subjected to relevant flows and exposure conditions. Testing will initially be performed at smaller scaled and eventually-scaled up for simulated concrete repairs of relevant structural components and systems (e.g., the top of a lock wall). Another critical component of this research is the development of new testing protocols and guidance that consider the mechanical properties of the material and its long-term durability when subjected to anticipated exposure conditions.



Products

Material properties of optimized mixture proportions for making high quality repairs will be developed, including in-house concrete formulations, pre-packaged repair materials, shrinkage reducing admixtures, and fiber reinforcement. New guidance related to these materials and standardized testing protocols to evaluate mechanical properties and durability for various applications will also be developed and vetted using various repair materials.

Benefits

This research will develop a robust set of standardized testing protocols that can be utilized by District engineers to evaluate relevant properties of various repair materials. It will also identify optimal repair materials, admixtures, and fiber reinforcement for various repairs.

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